OSHPD Office of Statewide Health Planning and Development

Hospital Building Safety Board
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*** SPECIAL NOTICE ***

Because of the COVID-19 emergency, this meeting will only be held by teleconference. Committee members and members of the public may fully participate from their own locations.

NOTICE OF PUBLIC MEETING

HOSPITAL BUILDING SAFETY BOARD

Structural and Nonstructural Regulations Committee

Date:
Wednesday, January 27, 2021
9:00 a.m. – 3:00 p.m.

Teleconference Meeting Access:
HBSB GoToMeeting SNSR Committee
Access Code: 250-144-469

For more detailed instructions on how to join via GoToMeeting, see page 3.

Committee Members:
Rami Elhassan, Chair; Jim Malley, Vice-Chair; Bruce Clark; Mike Hooper; David Khorram; Marshall Lew; Michelle Malone*; Michael O'Connor; Jennifer Thornburg

OSHPD Staff:
Joe LaBrie; Roy Lobo; David Neou; Carl Scheuerman; Jamie Schnick; Ali Sumer

OSHPD Director:
Elizabeth Landsberg

FDD Deputy Director:
Paul Coleman

Executive Director:
Ken Yu

*Consulting Member

3. **Proposed amendments to the 2022 California Building Code, Title 24, Parts 1 and 2**

   Facilitators: Hussain Bhatia, Ali Sumer, Roy Lobo, Chris Tokas, OSHPD (or designees)

   - Modify ASCE 7-16 Section 11.4.8 site response analysis exceptions, to include supplement 3
   - Permit use of the multi-period spectrum in the ASCE 7-22 as an alternative to the response spectrum in ASCE 7-16
   - Clarify exemption language for anchorage and bracing of wall/ceiling hung equipment
   - Revisions to Chapter 18A, Soils and Foundations, based on changes made in the 2021 International Building Code and coordination with the California Division of the State Architect
   - Discussion and public input

Proposed Revisions for 2022 CBC to include Multi-Period Spectra

Hussain Bhatia, Ph.D., S.E. – Supervisor, Coastal Region

ASCE 7-16 Supplement 2 and 3

- ASCE 7-16 Supplement 2 - This Supplement updates two sections of the standard: Section 12.9.1.5, which clarifies Horizontal Shear Distribution provisions for torsional effects, and Section 16.4.2.1, which updates Force-Controlled Actions provisions to align with industry standards specifically the 2017 PEER TBI Guideline. **Currently in public comment.**

- ASCE 7-16 Supplement 3 - Clarification of ASCE 7-16, Section 11.4.8 (Site Specific Ground Motion Procedures). **Ballot complete and will be in public comments soon.**

Multi-period Spectra – ASCE 7-22/NEHRP 2020

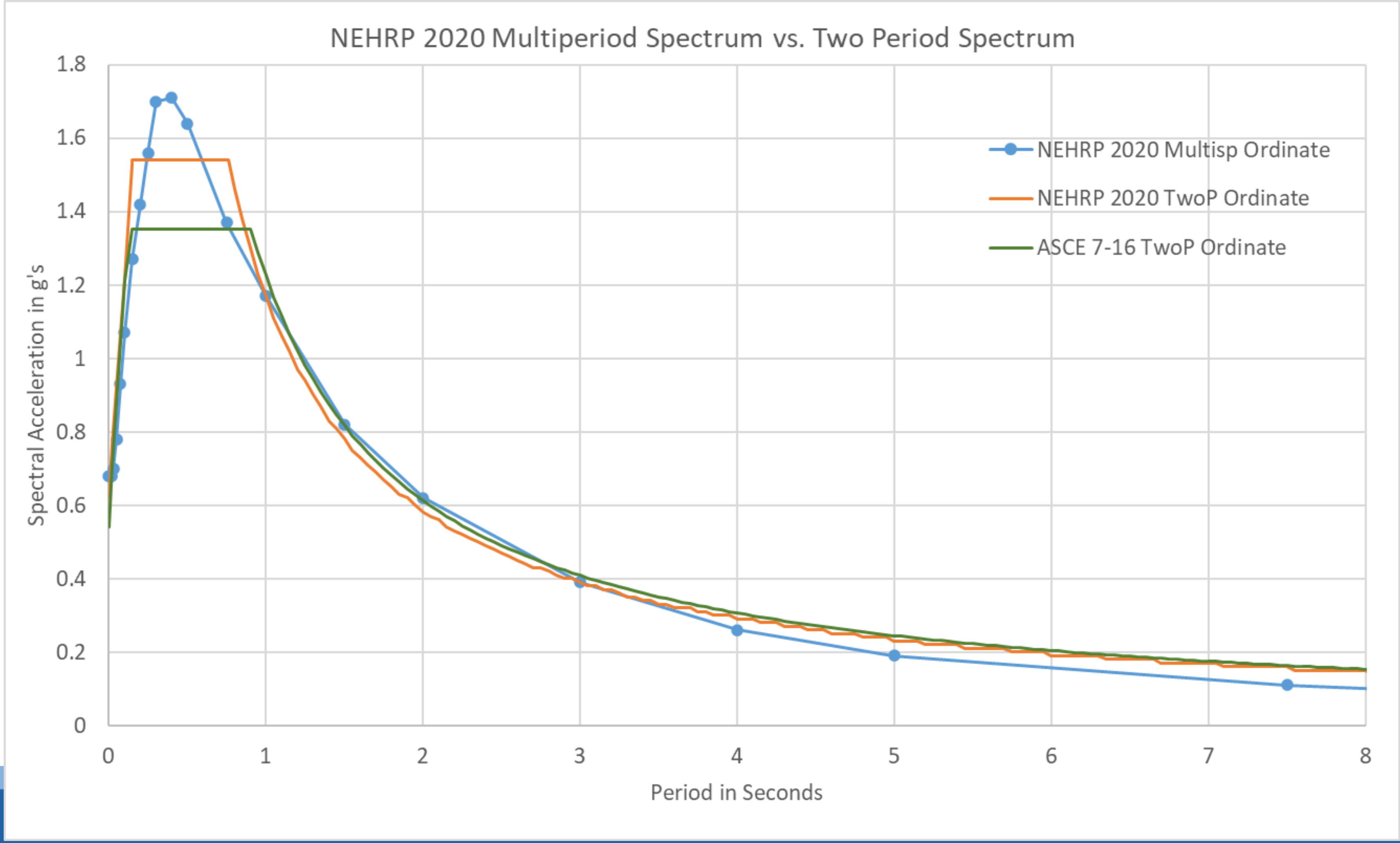
- Uses 22 points – available using a JSON query from the USGS or from ASCE Hazard Tool. Simple to use with modern technology.
- This is still a proposal which in the final stages of approval in ASCE 7-22:

11.4.5.1 Multi-Period Design Response Spectrum.
The multi-period design response spectrum shall be developed as follows:

1. *At discrete values of period, T, equal to 0.0 s, 0.01 s, 0.02 s, 0.03 s, 0.05 s, 0.075 s, 0.1 s, 0.15 s, 0.2 s, 0.25 s, 0.3 s, 0.4 s, 0.5 s, 0.75 s, 1.0 s, 1.5 s, 2.0 s, 3.0 s, 4.0 s, 5.0 s, 7.5 s and 10 s, the 5%-damped design spectral response acceleration parameter,* S_a*, shall be taken as 2/3 of the multi-period 5%-damped* MCE_R *response spectrum from the USGS Seismic Design Geodatabase for the applicable site class.*
2. *At each response period, T, less than 10 s and not equal to one of the discrete values of period, T, listed in Item 1 above,* S_a*, shall be determined by linear interpolation between values of* S_a*, of Item 1 above.*
3. *At each response period, T, greater than 10 s,* S_a*, shall be taken as the value of* S_a *at the period of 10 s of Item 1 above, factored by 10/T, where the value of T is less than or equal to that of the long-period transition period,* T_L*, and shall be taken as the value of* S_a *at the period of 10 s factored by* $10T_L/T^2$*, where the value of T is greater than that of the long-period transition period,* T_L*.*

Multi-period Spectra – NEHRP 2020/ASCE 7-22

- Still allows use of the equivalent 2-point spectra – such as for nonstructural components.



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However, Multi-period Spectra tied to Site Class

ASCE 7-16

Table 20.3-1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard rock	>5,000 ft/s	NA	NA
B. Rock	2,500 to 5,000 ft/s	NA	NA
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50 blows/ft	>2,000 lb/ft^2
D. Stiff soil	600 to 1,200 ft/s	15 to 50 blows/ft	1,000 to 2,000 lb/ft^2
E. Soft clay soil	<600 ft/s	<15 blows/ft	<1,000 lb/ft^2
	Any profile with more than 10 ft of soil that has the following characteristics: — Plasticity index $PI > 20$, — Moisture content $w \geq 40\%$, — Undrained shear strength $\bar{s}_u < 500$ lb/ft^2		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

Note: For SI: 1 ft = 0.3048 m; 1 ft/s = 0.3048 m/s; 1 lb/ft^2 = 0.0479 kN/m^2.

ASCE 7-22 - Proposed

Table 20.3-1 Site Classification

Site Class	v_s	N or N_{ch}	s_u
A. Hard rock	> 5,000 ft/s	NA	NA
B. Medium hard Rock	> 3,000 to-5,000 ft/s	NA	NA
BC. Soft rock	> 2,100 to 3,000 ft/s	NA	NA
C. Very dense sand or hard clay	> 1,450 to 2,100 ft/s		
CD. Dense sand or very stiff clay	> 1,000 to 1,450 ft/s	> 30 to 50 blows/ft	> 1,500 to 2,000 lb/ft^2
D. Medium dense sand or stiff clay	> 700 to 1,000 ft/s	> 15 to 30 blows/ft	> 1,000 to 1,500 lb/ft^2
DE. Loose sand or medium stiff clay	> 500 to 700 ft/s	≥ 10 to 15 blows/ft	≥ 500 to 1,000 lb/ft^2
E. Very loose sand or soft clay	≤ 500 ft/s	< 10 blows/ft	< 500 lb/ft^2
	See Section 20.3.2 for special case		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

6 site classes in ASCE 7-16 have become 9 in ASCE 7-22

So NOT one-to-one correspondence.

Proposed Language

***1617A.1.3** <u>**ASCE 7, Section 11.4. Modify ASCE 7, Section 11.4 to include the following:**</u>*

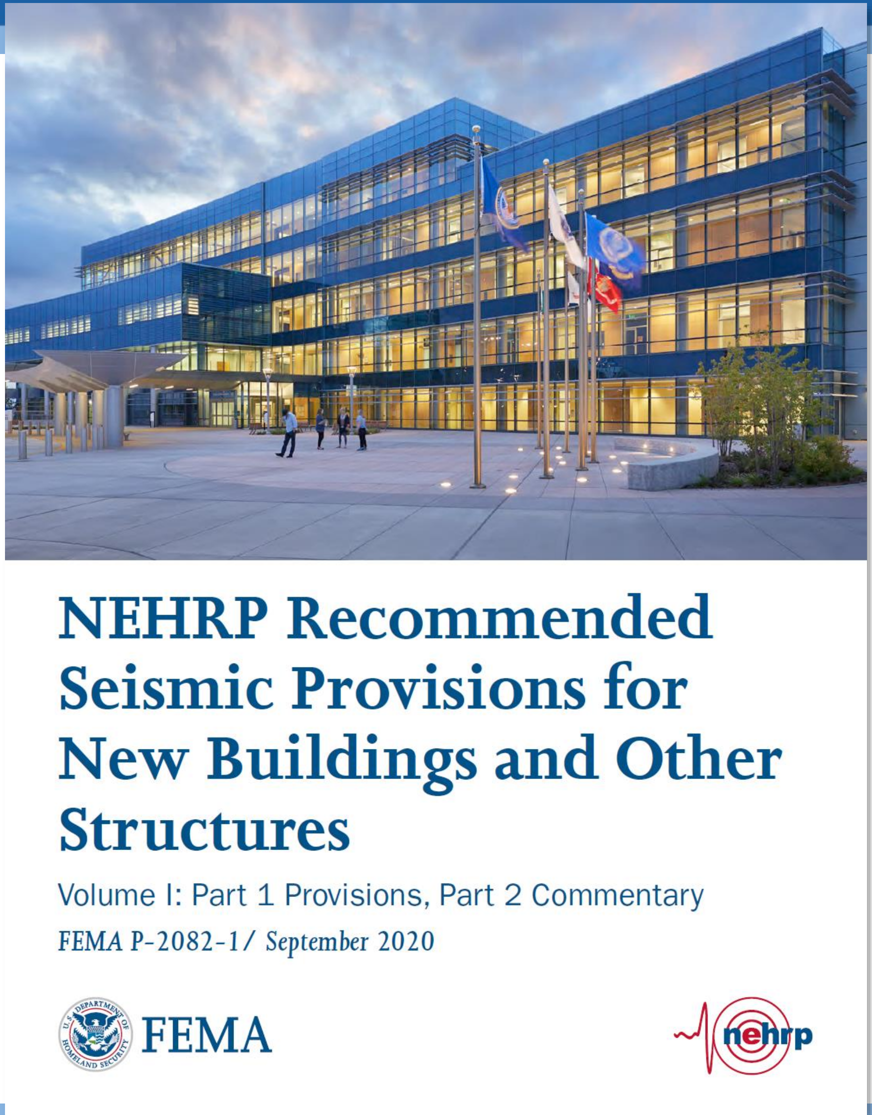
<u>Seismic ground motion values shall include updated subsections in Supplement 3.</u>

<u>Use of the 2020 NEHRP Provisions for multi-period spectra shall be permitted, where all of the following are included.:</u>

1. *<u>A detailed seismic design criterion shall be submitted to and approved by the AHJ.</u>*
2. *<u>Seismic Ground Motion values shall be determined using the 2020 NEHRP Provisions, Section 11.4.</u>*
3. *<u>Geologic Hazard and Geotechnical Investigation shall be performed using the 2020 NEHRP Provisions, Section 11.8.</u>*
4. *<u>Vertical Ground Motions, where required, shall be determined using the 2020 NEHRP Provisions, Section 11.9.</u>*
5. *<u>Site Classification shall be determined using the 2020 NEHRP Provisions, Chapter 20.</u>*
6. *<u>Site Specific Ground Motion Procedures shall be determined using the 2020 NEHRP Provisions, Chapter 21.</u>*
7. *<u>Seismic Ground Motion and Long-period Transition Maps shall be used from Chapter 22 of the 2020 NEHRP Provisions.</u>*
8. *<u>S_{DS} and S_{D1} obtained from the multiperiod spectra determined using the 2020 NEHRP Provisions shall be used, where required in Chapter 12, 13 and 15 of ASCE 7-16.</u>*

NEHRP 2020 vs. ASCE 7-22

- NEHRP 2020 is a published FEMA document whereas ASCE 7-22 is still being balloted. So, reference to items in NEHRP 2020 was added rather than ASCE 7-22.
- ASCE 7-22 proposals are based on NEHRP 2020.
- NEHRP 2020 modifies sections in ASCE 7-16 in a manner similar to the CBC amendments.
- Only sections/chapters needed to characterize multiperiod spectrum added.



2. **Policy Intent Notice (PIN) 68 – Support and Attachment Requirements for Fixed, Interim, Mobile, Movable, Other and Temporary Equipment**

   Facilitators: Ali Sumer, OSHPD (or designee)

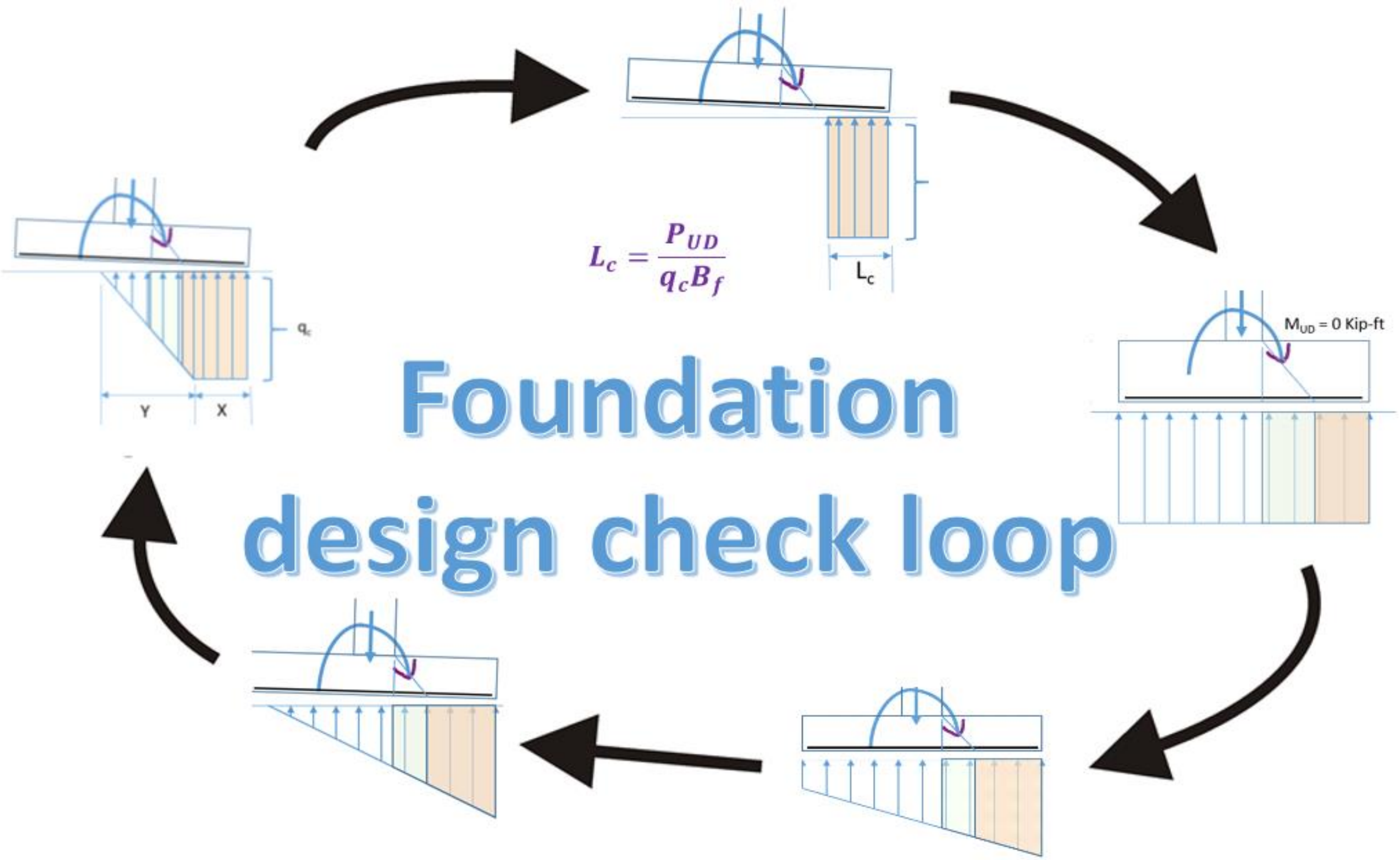
   - Incorporation of wall/ceiling hung equipment
   - Discussion and public input

4. **Proposed amendments to the 2022 California Building Code, Title 24, Part 10**

   Facilitators: Roy Lobo, Ali Sumer, OSHPD (or designees)

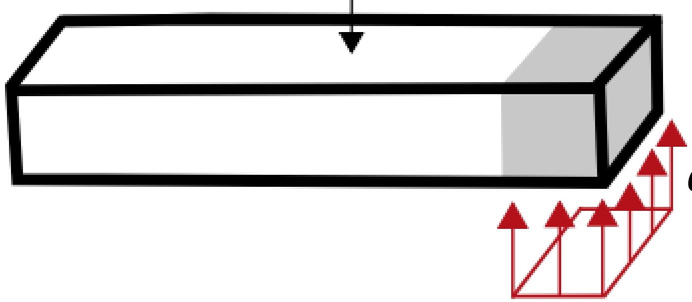
   - Modify/clarify the applicability of the exemption to performing a pounding analysis in ASCE 41 for buildings being upgraded to SPC-4D
   - Provide alternate overturning acceptance criteria for foundations evaluated with Chapter 8 of ASCE 41
   - Discussion and public input

Soil Pressure Distribution Under a Footing



Moment Capacity of an Isolated Footing

- Rectangular Footing – ASCE 41-13



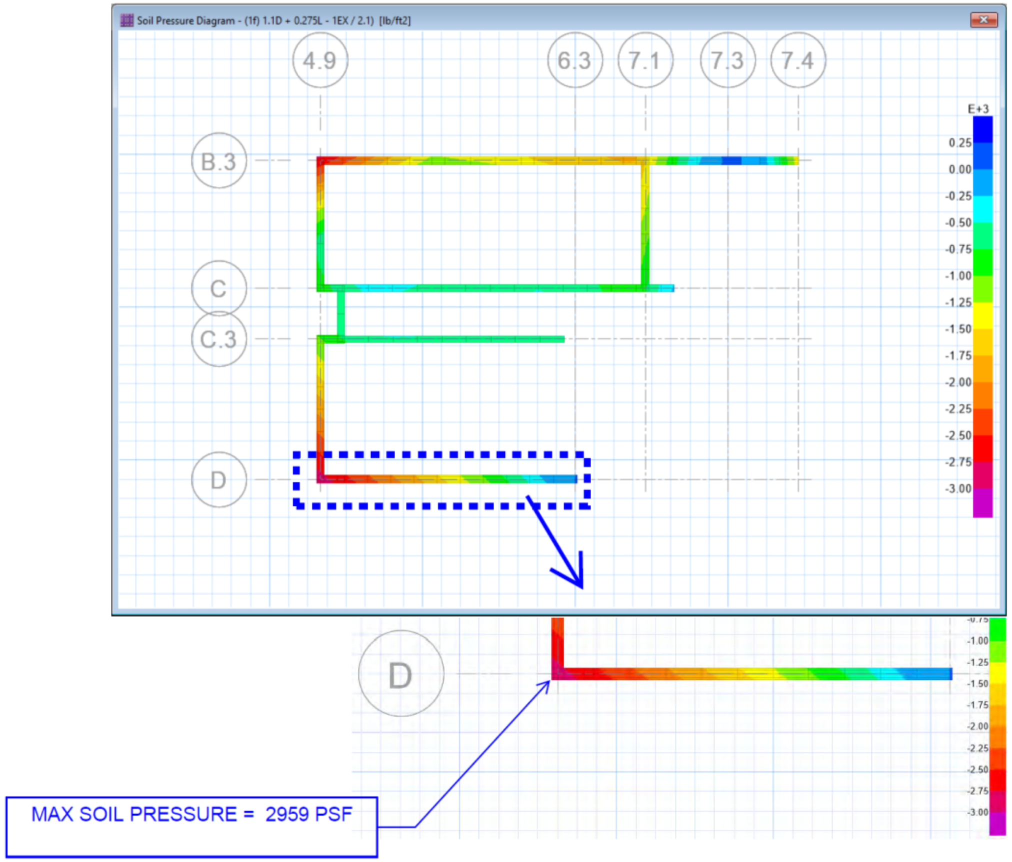
P = expected vertical load on soil at the footing interface due to gravity and seismic loads;
L_f = Length of the footing;
B_f = Width of the footing;
q_c = Expected bearing capacity

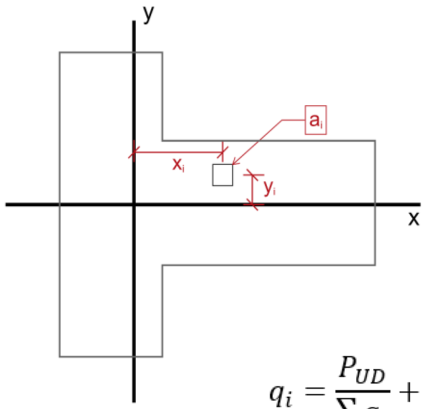
$$M_C = \frac{L_f P}{2}\left(1 - \frac{q}{q_c}\right)$$

$$q = \frac{P}{B_f L_f}$$

Acceptance Criteria based on Soil Pressure

- General Procedure for Foundation analysis.





$$q_i = \frac{P_{UD}}{\sum a_i} + \frac{M_{yy}I_{xx} + M_{xx}I_{xy}}{I_{xx}I_{yy} - I_{xy}I_{xy}}(x_i) - \frac{M_{xx}I_{yy} + M_{yy}I_{xy}}{I_{xx}I_{yy} - I_{xy}I_{xy}}(y_i)$$

Where:

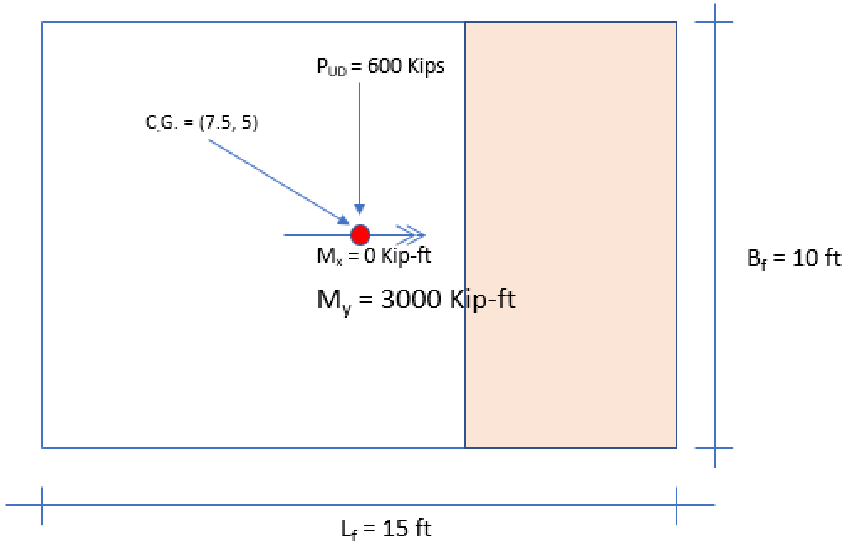
$$I_{xx} = \sum_{i=1}^{n} a_i y_i^2$$

$$I_{yy} = \sum_{i=1}^{n} a_i x_i^2$$

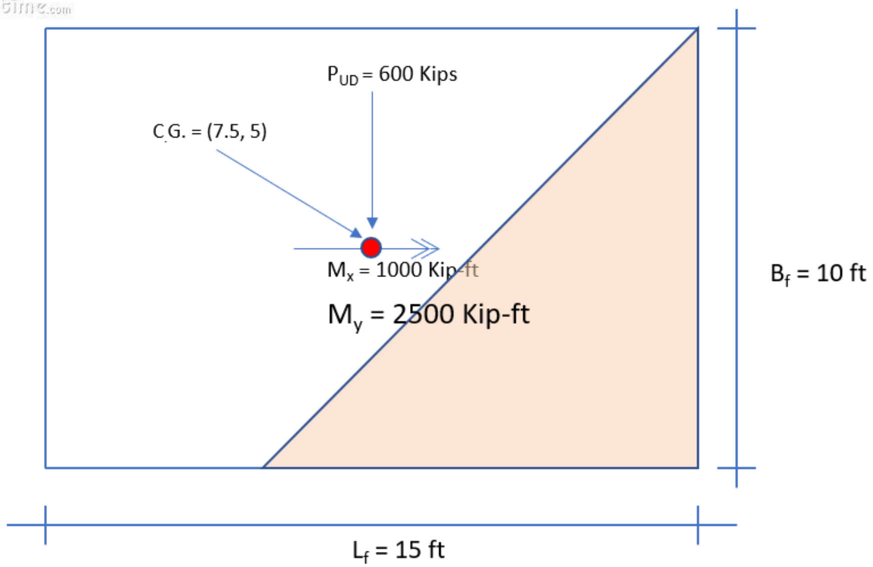
$$I_{xy} = \sum_{i=1}^{n} a_i x_i y_i$$

Moment Capacity M_C Vs Max Pressure q_c

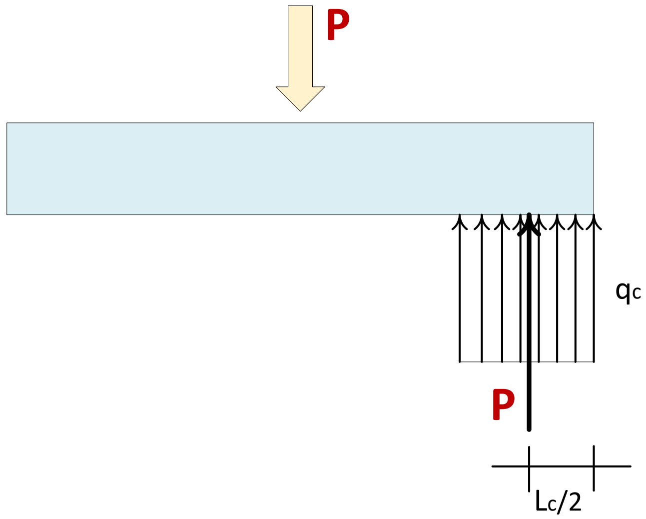
- Can soil bearing be used as a surrogate for moment capacity of a footing?
  - Uniaxial Loading
  - Biaxial Loading

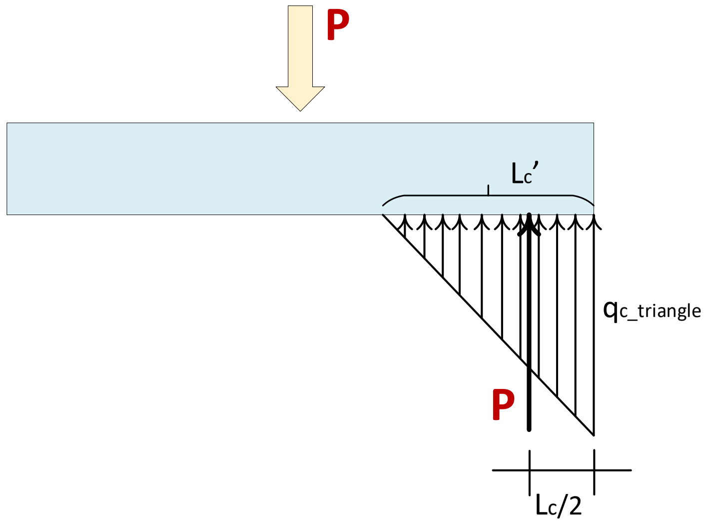


q_c = 12 ksf
A_c/A = 0.33



Rectangular Vs Triangular bearing Capacity q_c Uniaxial Moment

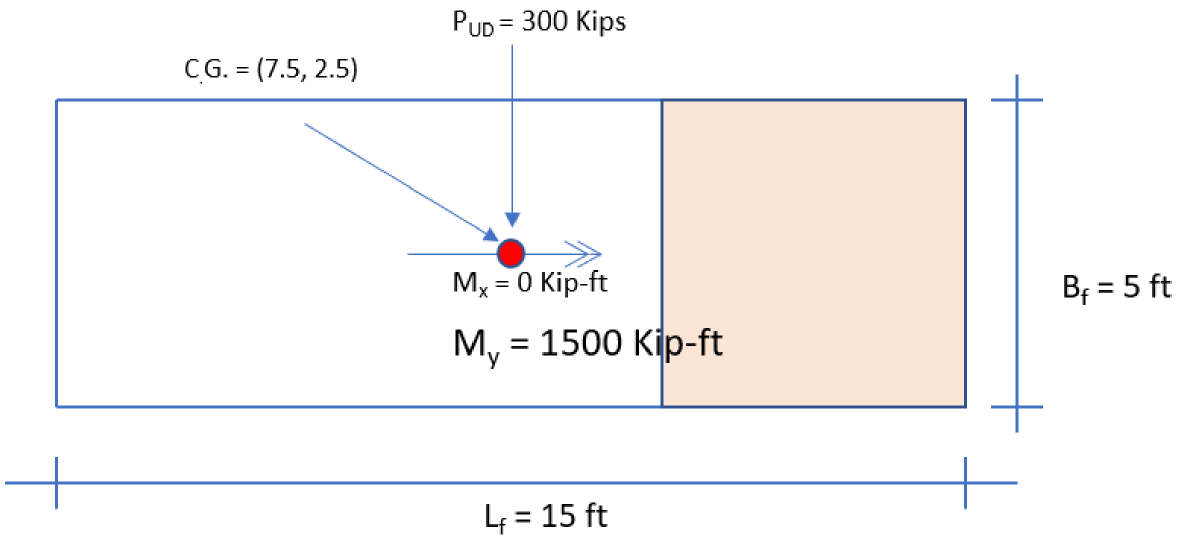


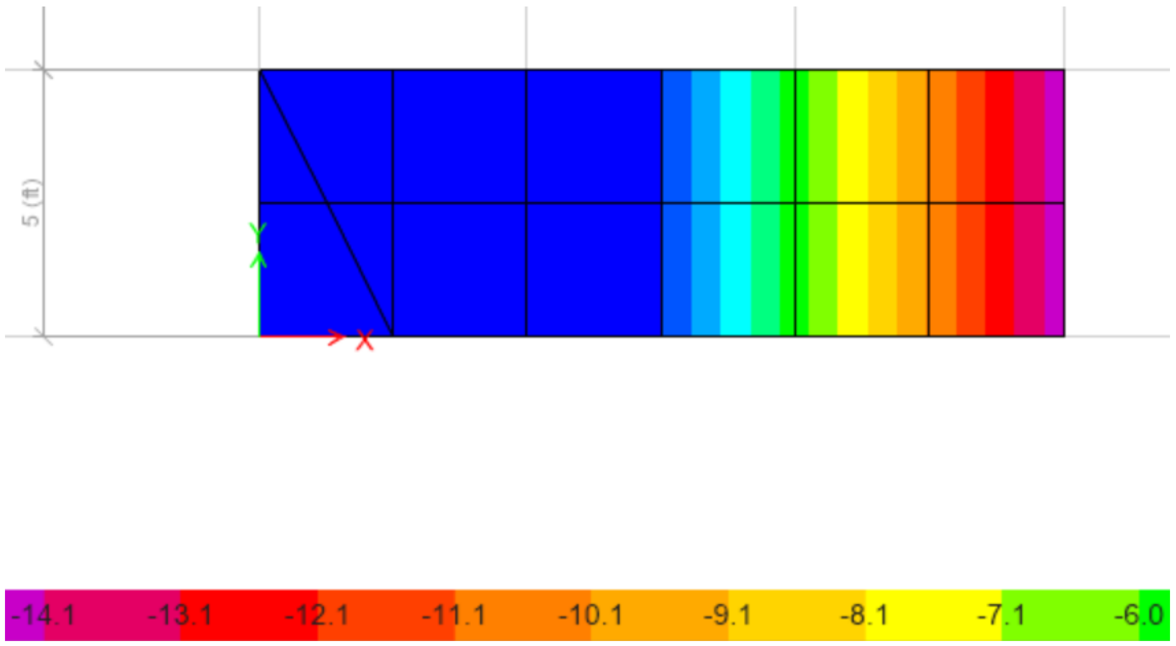


- For same overturning moment capacity M_{CE}, the centroid of rectangular soil pressure block should be at the same location as the centroid of the triangular soil pressure block.
  - $L_c/2 = L_c'/3$
  - $q_c B L_c = \frac{1}{2}(q_{c\_triangle} B L_c')$

$$q_{c\_triangle} = 4/3 q_c = 1.33 q_c$$

Rectangular Vs Triangular Soil Pressure





Rectangular Soil Pressure

q_c = 12 ksf

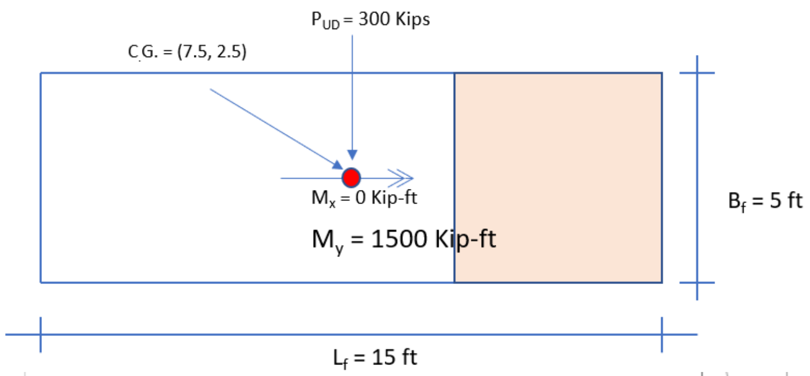
Ac/A = 0.33

Triangular Soil Pressure

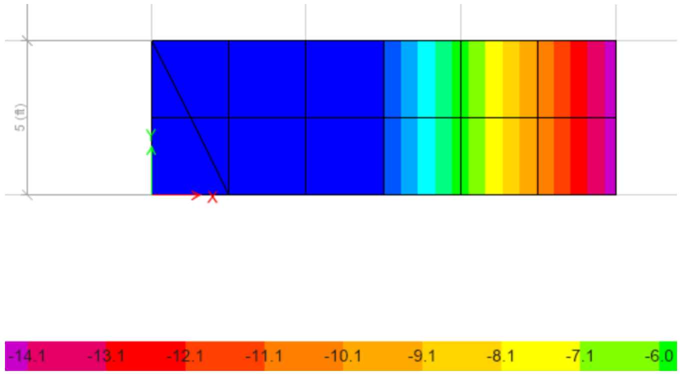
$q_{c\ max}$ = 14.75 ksf

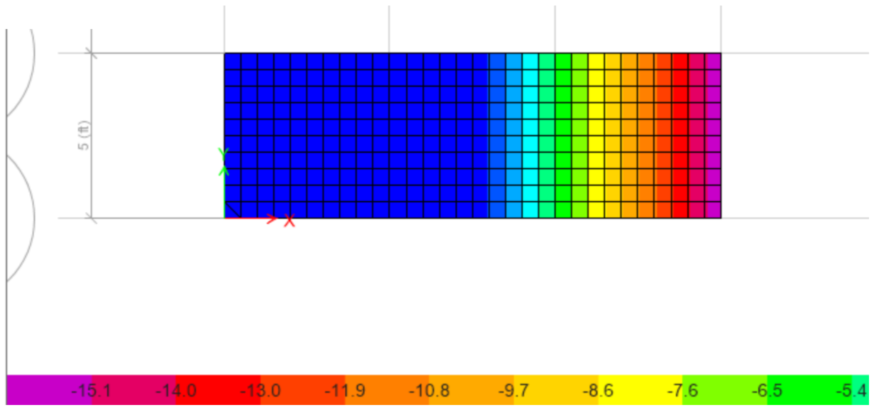
Ratio = 1.23

Effect of Mesh size



Ac/A = 0.33





Rectangular Soil Pressure

q_c = 14.75 ksf

Ratio = 1.23

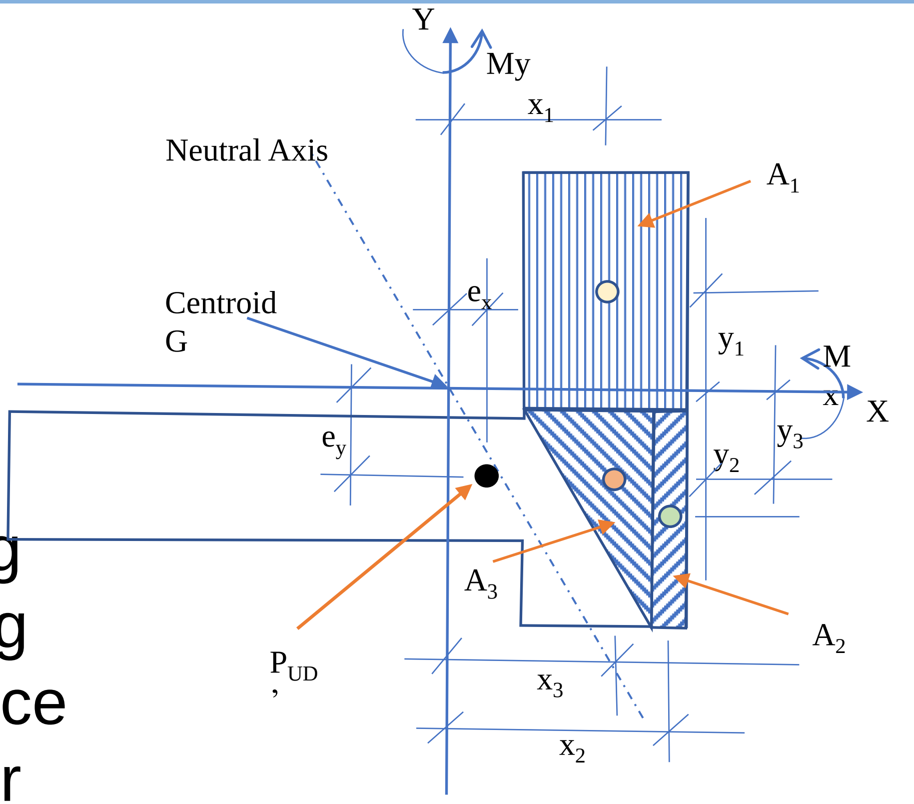
Triangular Soil Pressure

$q_{c\ max}$ = 15.9 ksf

Ratio = 1.32 → **1.33**

General Procedure for Determining Moment Capacity

Moment Capacity M_{CE} including Biaxial Loading



- Moment Capacity M_{CE} is determined by integrating the product of the bearing capacity times the distance from the neutral axis over the critical contact area A_c.
- $A_c = P_{UD}'/q_c$

Solve Simultaneously for $A_c = \sum A_i$

$$q_c \sum_{i=1}^{n} A_i x_i - P_{UD} Y_c + M_x = 0$$

and

$$q_c \sum_{i=1}^{n} A_i = P_{UD}$$

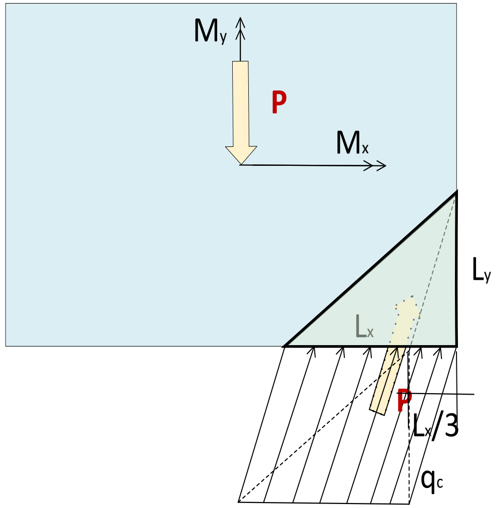
Calculate

$$M_y = q_c \sum_{i=1}^{n} A_i y_i - P_{UD} X_c$$

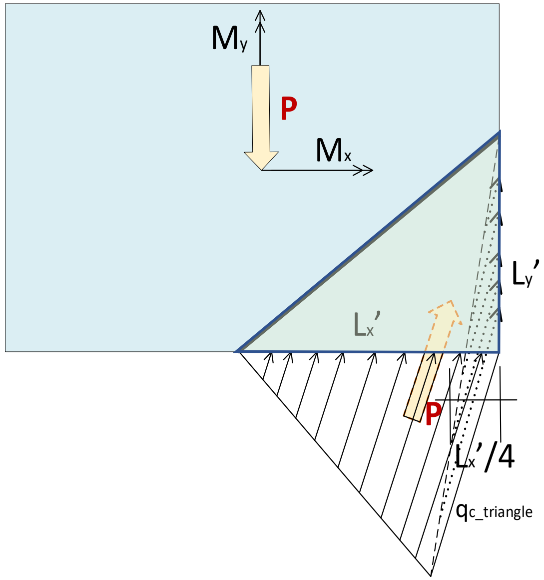
Total Moment Capacity

$$M_{CE} = \sqrt{(M_x)^2 + (M_y)^2}$$

Rectangular Vs Triangular bearing Capacity q_c with Biaxial Moment on the Footing



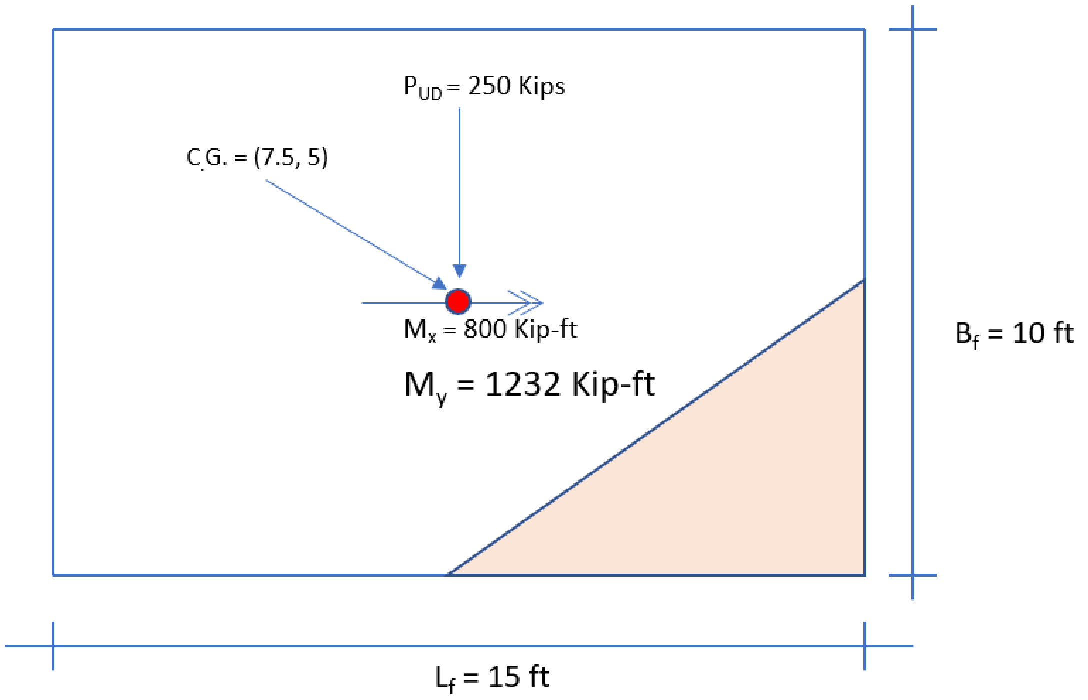
$q_{c\_triangle} / q_c \approx 1.687$



- For same overturning moment capacity M_{CE}, the centroid of triangular prism soil pressure block should be at the same location as the centroid of the triangular pyramid soil pressure block.

$q_{c\_triangle} / q_c = 3(L_x L_y / L_x' L_y');$ $L_x' = 1.33 L_x ; L_y' = 1.33 L_y$

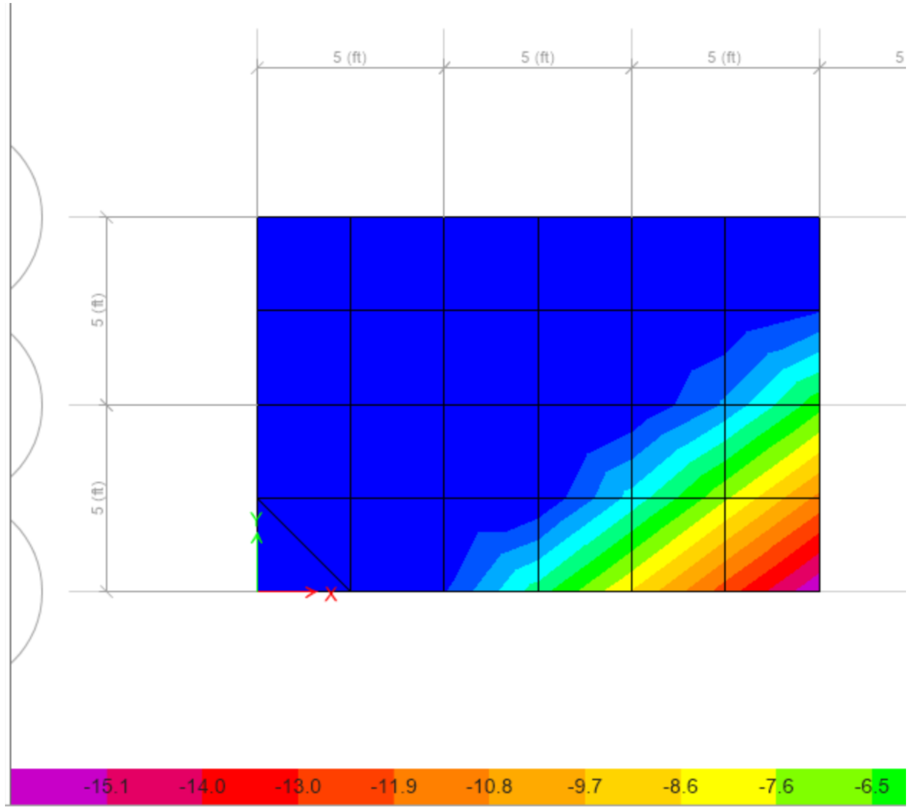
Rectangular Vs Triangular Soil Pressure



Rectangular Soil Pressure

q_c = 12 ksf

A_c/A = 0.14

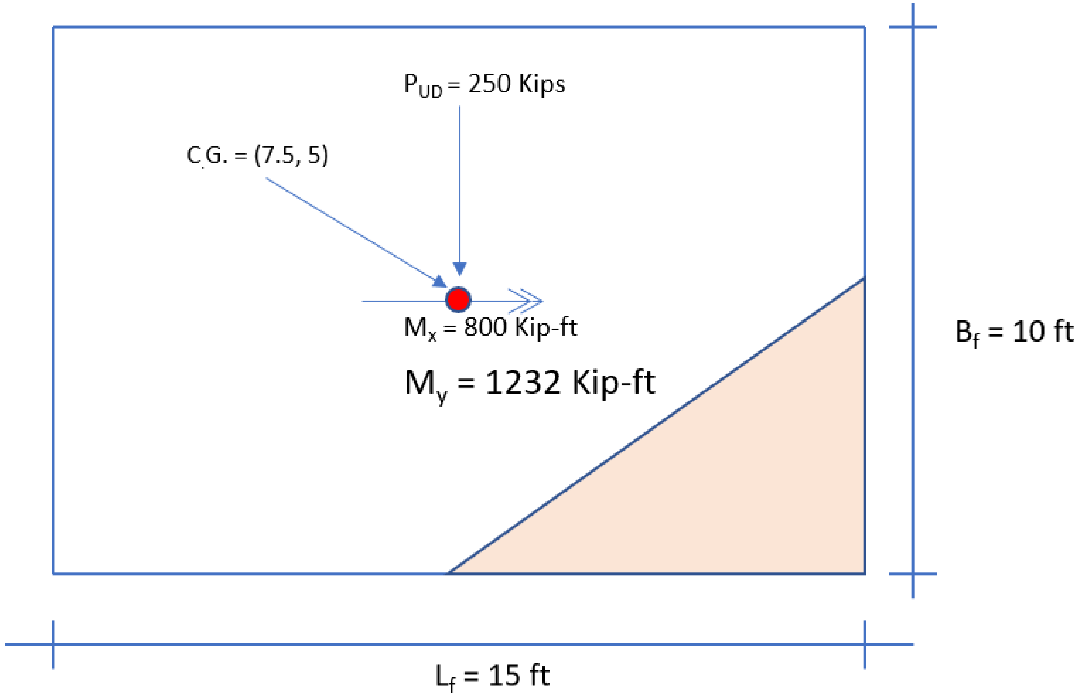


Triangular Soil Pressure

q_{max} = 16.15 ksf

Ratio = 1.35

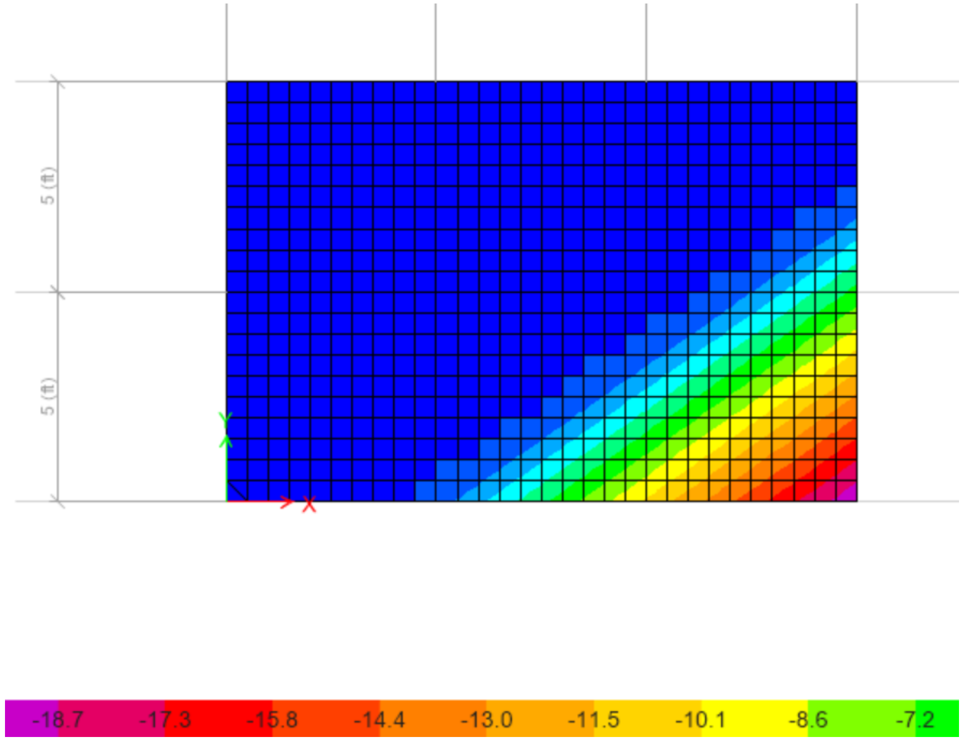
Rectangular Vs Triangular Soil Pressure



Rectangular Soil Pressure

q_c = 12 ksf

A_c/A = 0.14

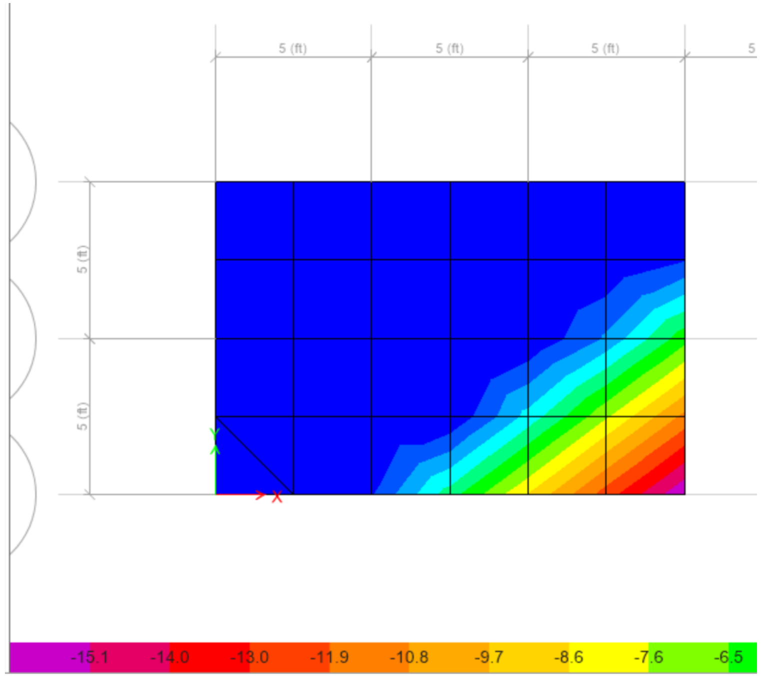


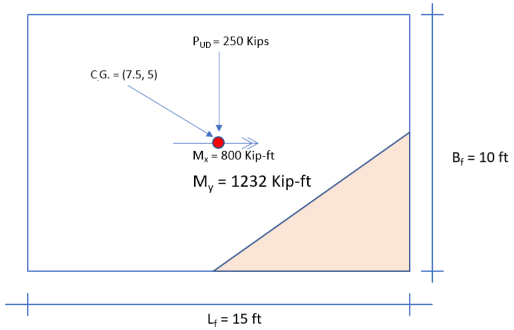
Triangular Soil Pressure

q_{max} = 19.97 ksf

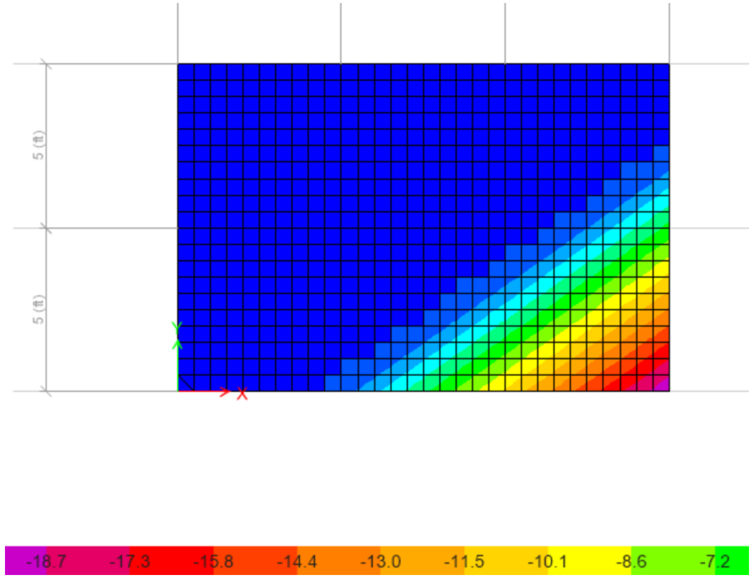
Ratio = 1.66

Effect of Mesh Size





q_c = 12 ksf
A_c/A = 0.14



Triangular Soil Pressure

q_{max} = 16.15 ksf

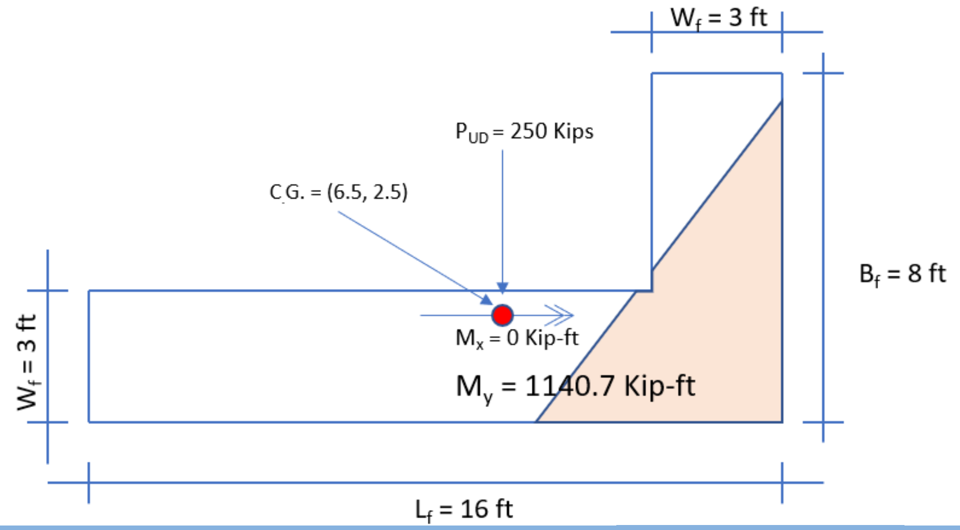
Ratio = 1.35

Triangular Soil Pressure

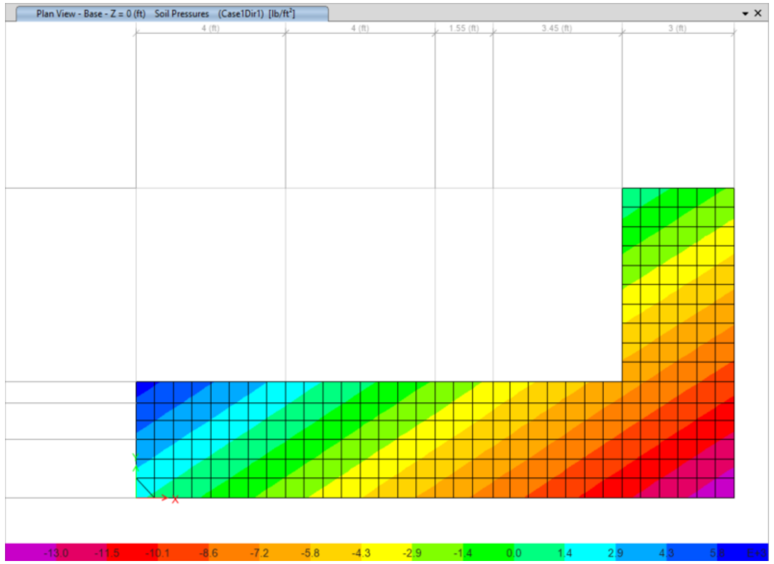
q_{max} = 19.97 ksf

Ratio = 1.66 **1.687**

Footings with an Unequal Angle Shape



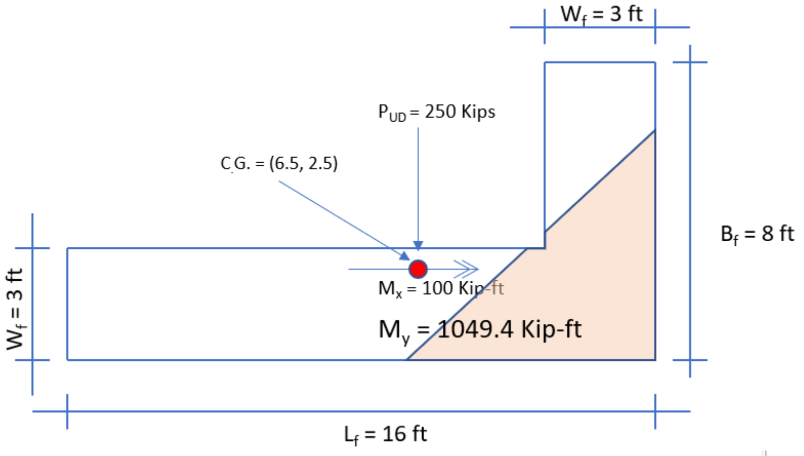
Rectangular Vs Triangular Soil Pressure



Soil Takes Tension

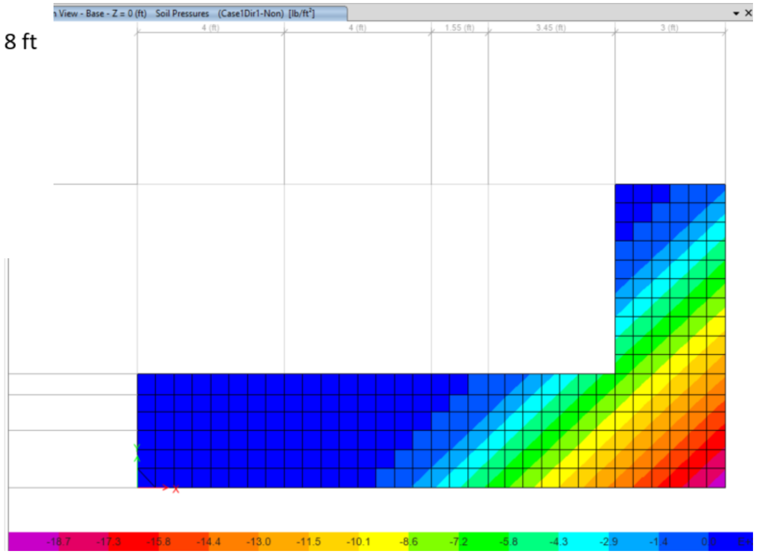
Soil Pressure q_{e_max} = 14.2 ksf

Ratio = 1.18



$q_{c\_expected}$ = 12 ksf

A_c/A = 0.33

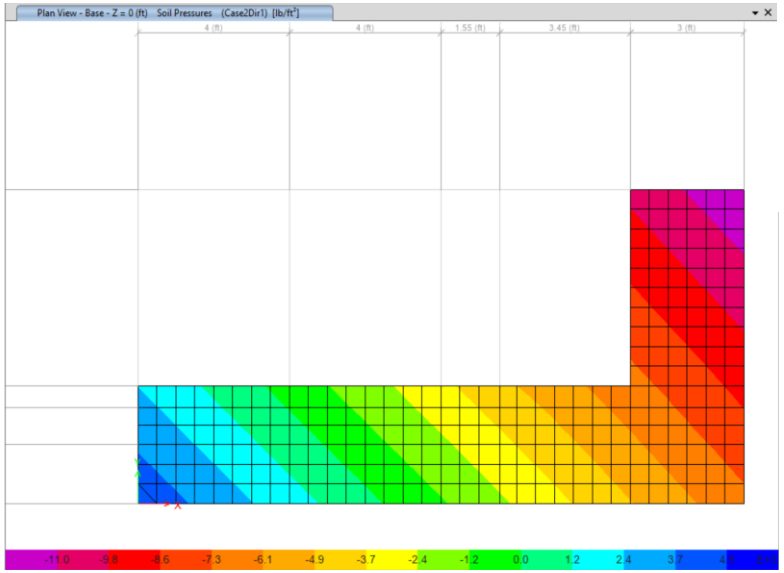


Compression only springs

q_{i_max} = 19.78 ksf

Ratio = 1.65

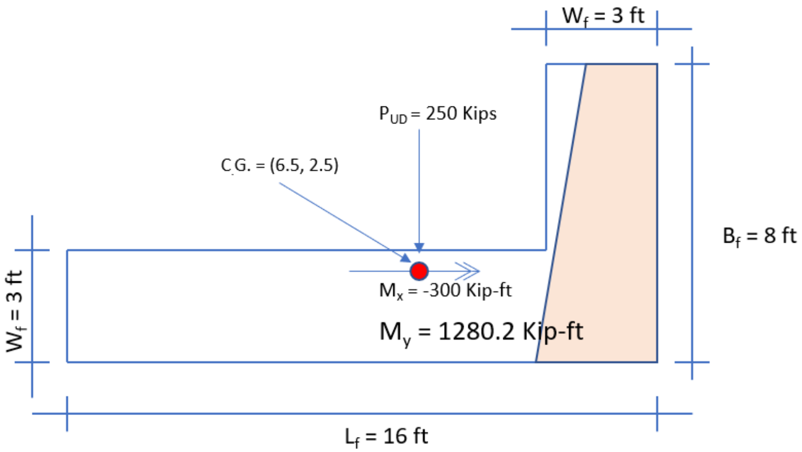
Rectangular Vs Triangular Soil Pressure



Soil Takes Tension

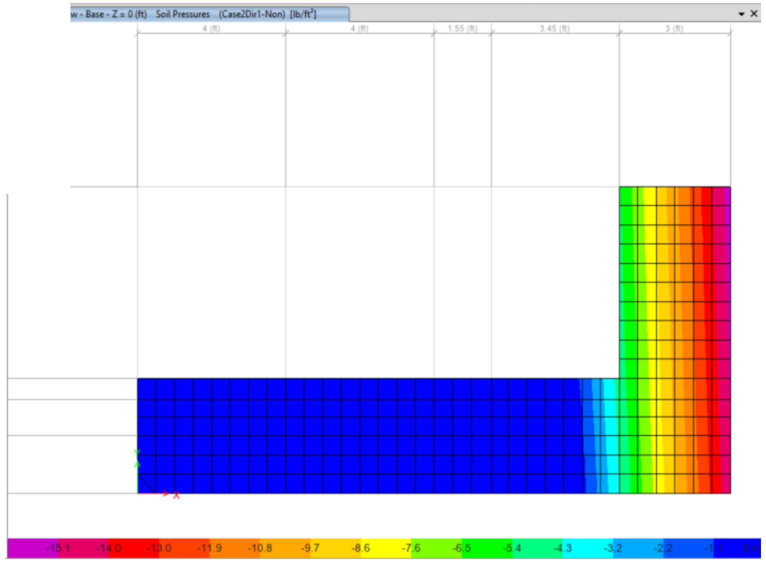
Soil Pressure q_{e_max} = 12.1 ksf

Ratio = 1.0



$q_{c\_expected}$ = 12 ksf

A_c/A = 0.33

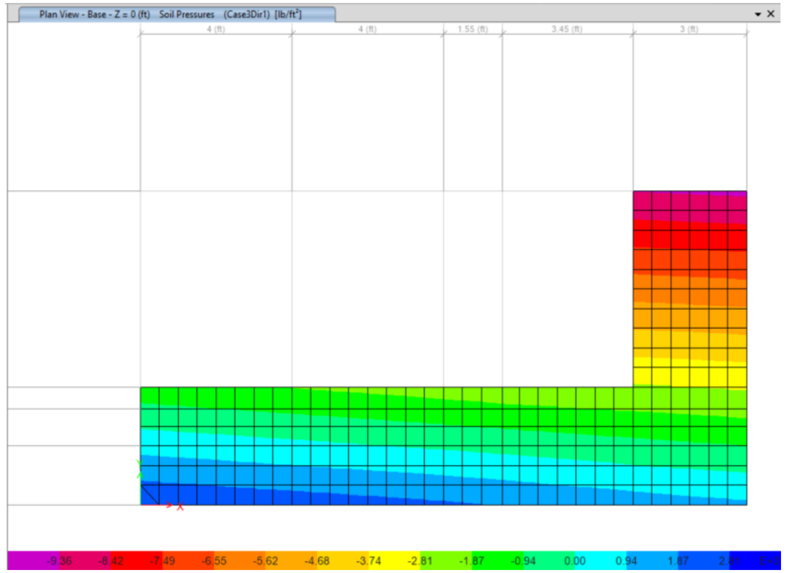


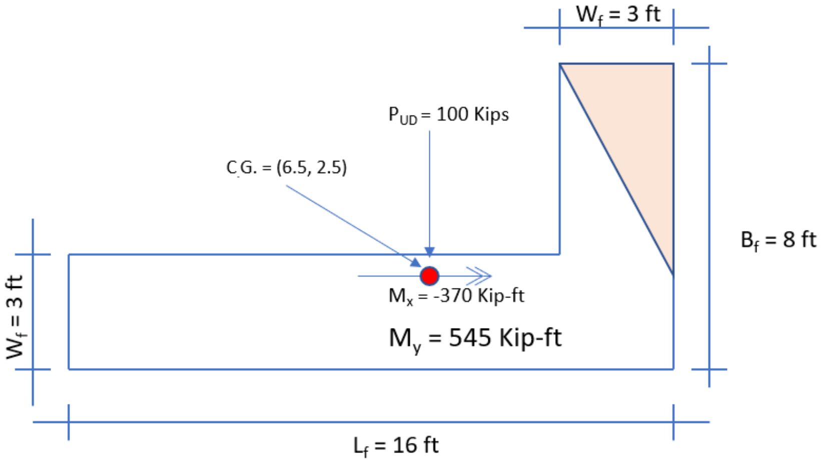
Compression only springs

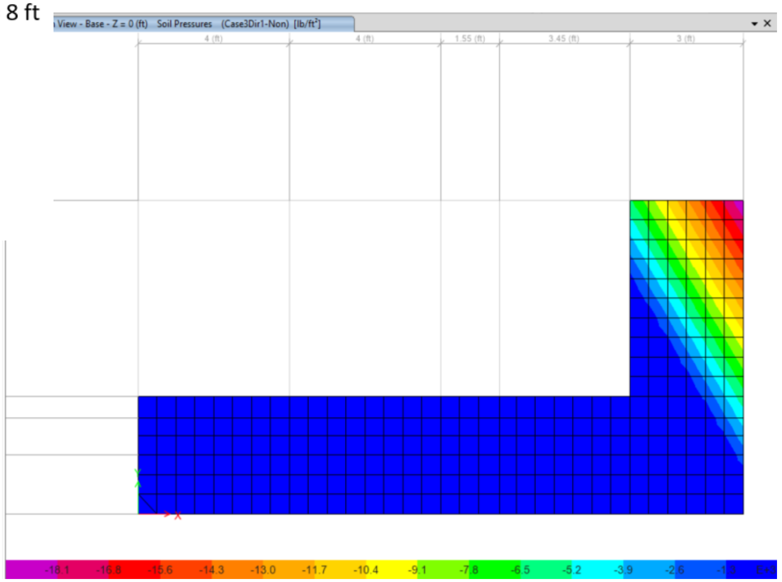
q_{i_max} = 15.66 ksf

Ratio = 1.31

Rectangular Vs Triangular Soil Pressure







$q_{c\_expected}$ = 12 ksf

A_c/A = 0.13

Soil Takes Tension

Soil Pressure q_c = 9.6 ksf

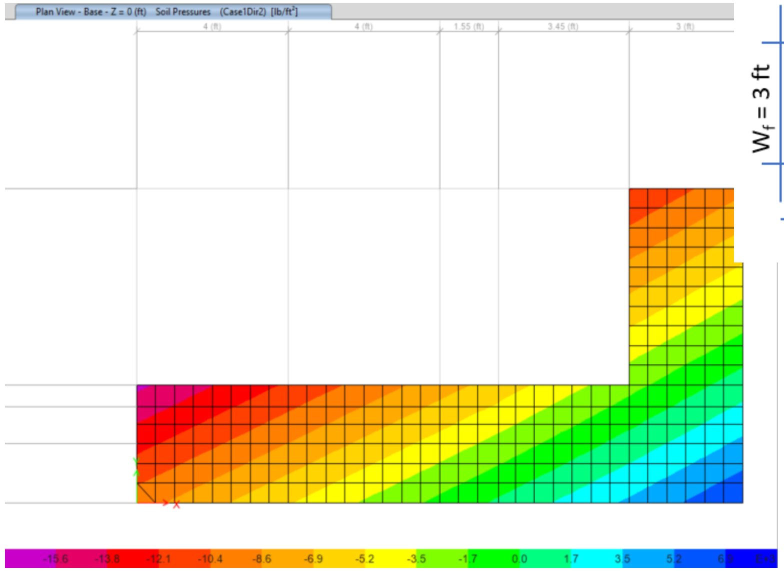
Ratio = 0.8

Compression only springs

q_c max = 19.3 ksf

Ratio = 1.61

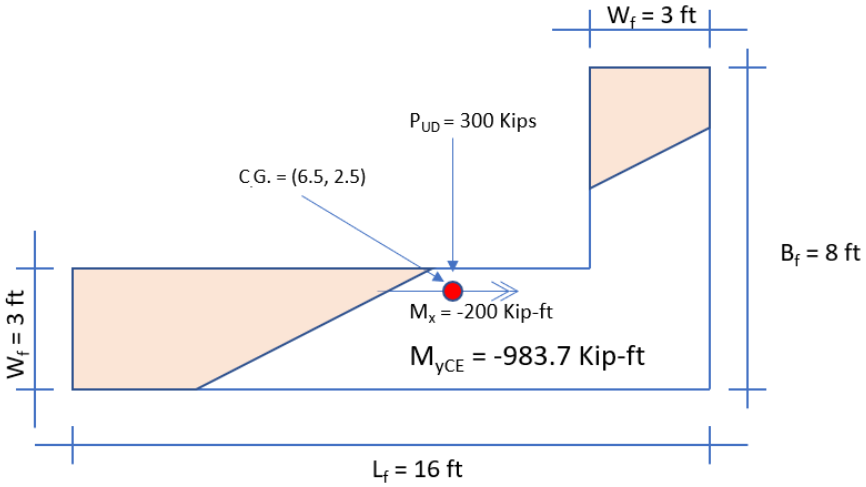
Rectangular Vs Triangular Soil Pressure



Soil Takes Tension

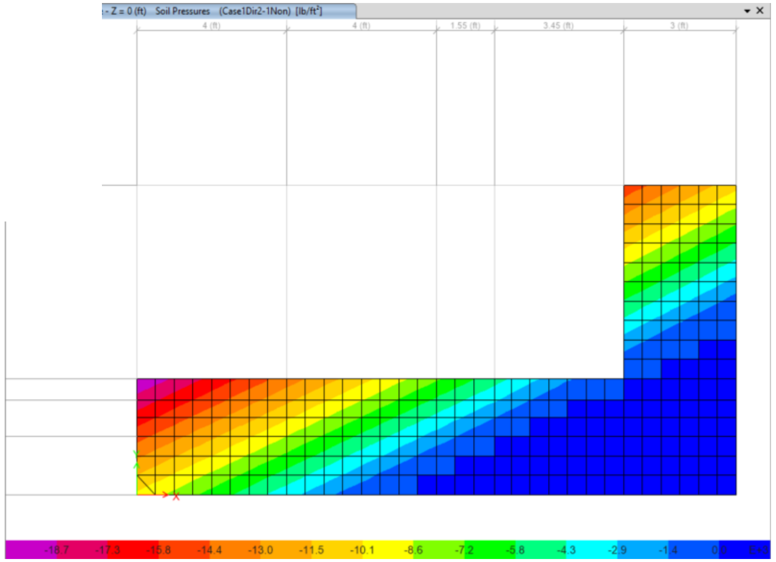
Soil Pressure q_c = 15.97 ksf

Ratio = 1.33



$q_{c\_expected}$ = 12 ksf

A_c/A = 0.4

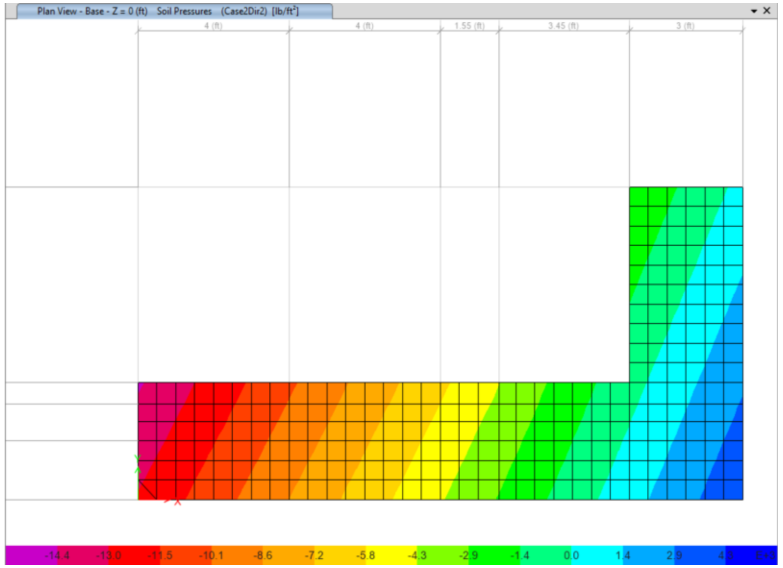


Compression only springs

q_c max = 20.1 ksf

Ratio = 1.68

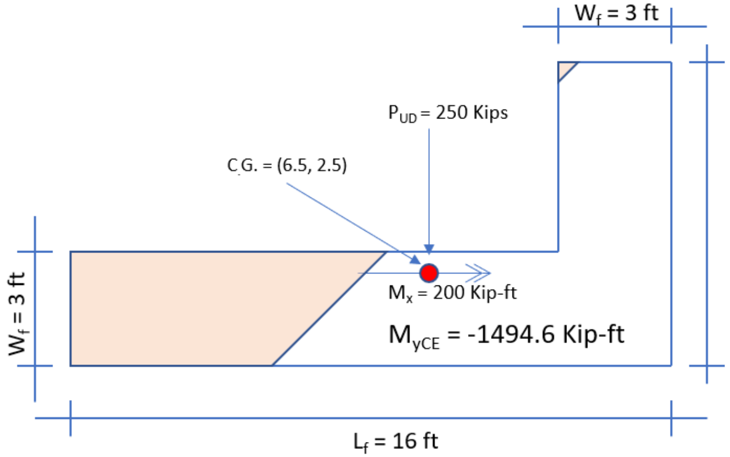
Rectangular Vs Triangular Soil Pressure



Soil Takes Tension

Soil Pressure q_c = 14.6 ksf

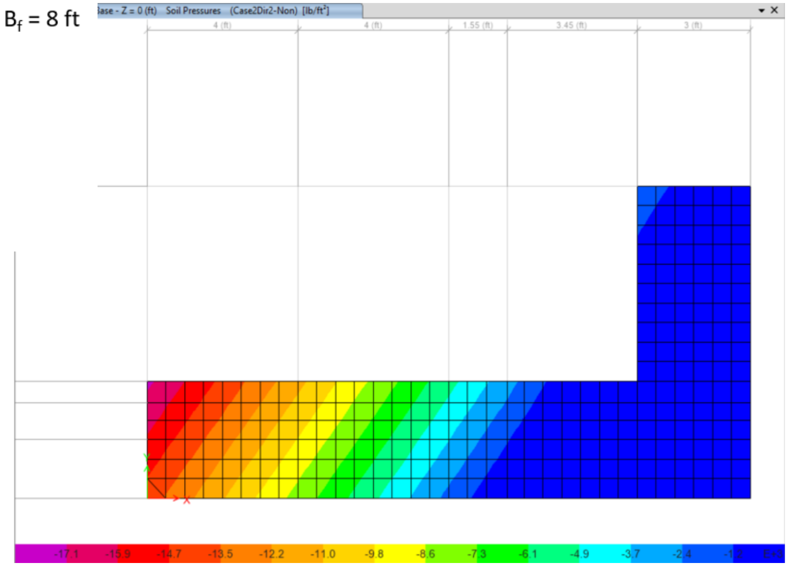
Ratio = 1.22



$q_{c\_expected}$ = 12 ksf

A_c/A = 0.33

B_f = 8 ft

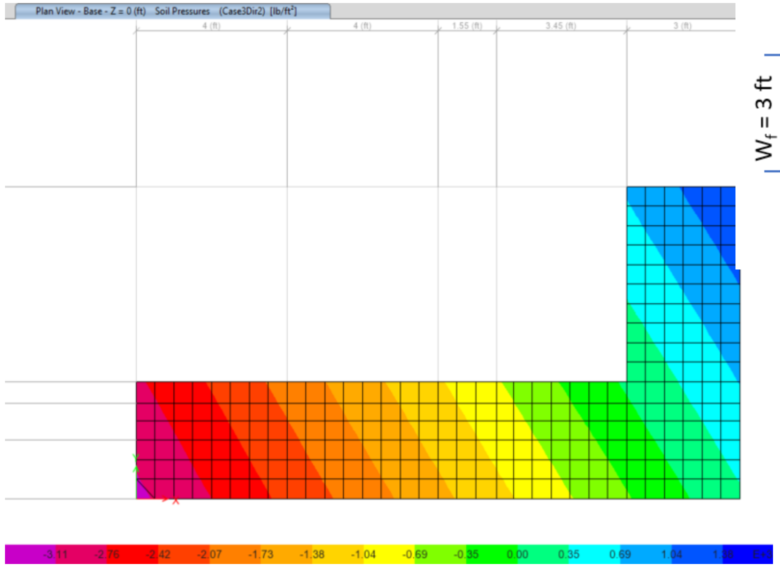


Compression only springs

q_c max = 17.4 ksf

Ratio = 1.45

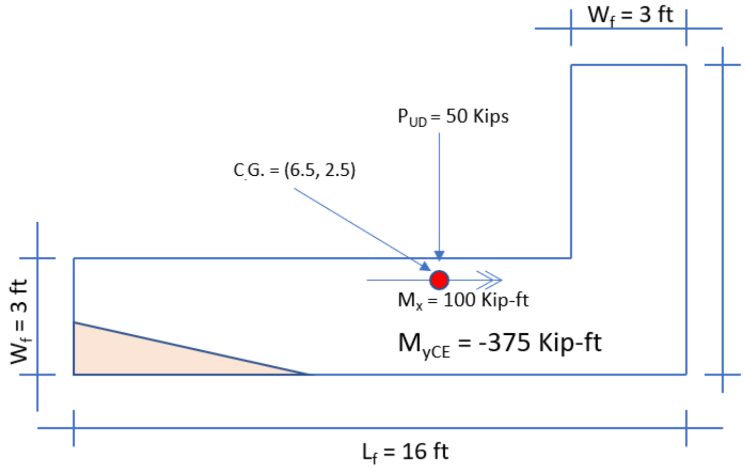
Rectangular Vs Triangular Soil Pressure



Soil Takes Tension

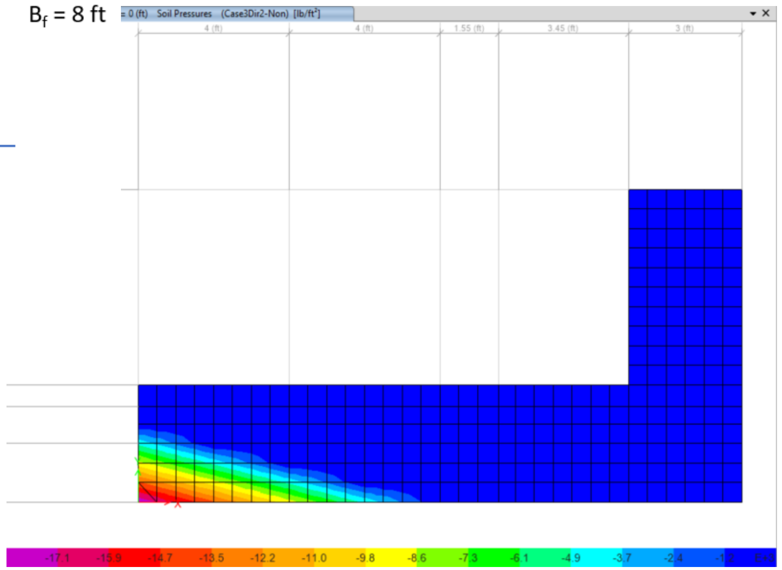
Soil Pressure q_c = 3.2 ksf

Ratio = 0.26



$q_{c\_expected}$ = 12 ksf

A_c/A = 0.07



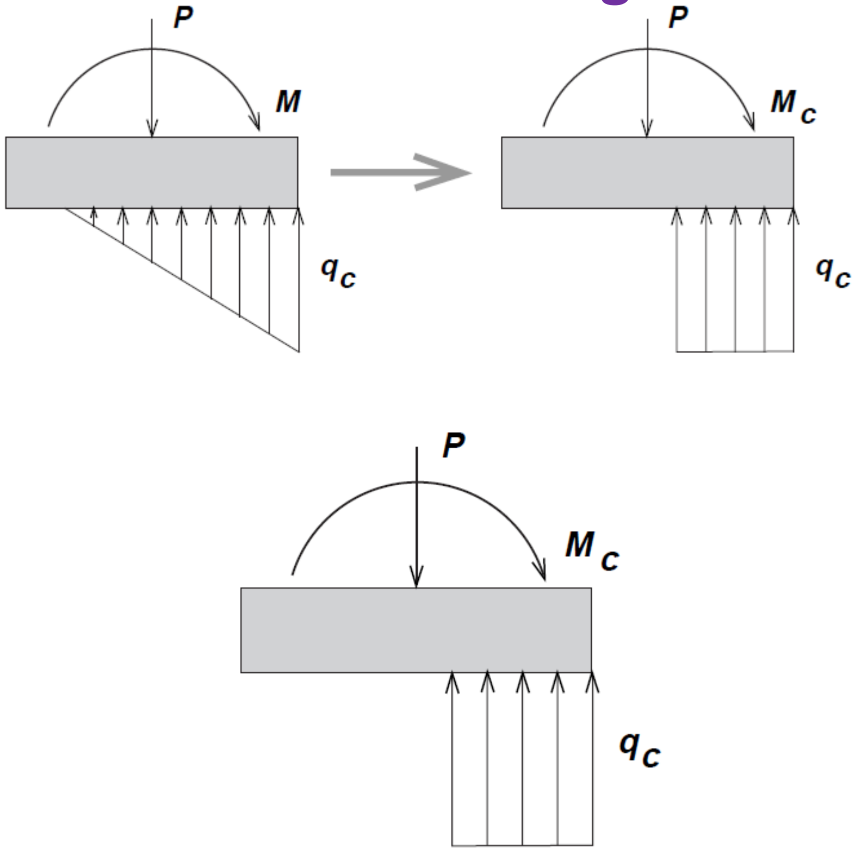
Compression only springs

q_{i_max} = 18.2 ksf

Ratio = 1.51

Shallow Footings Considered Rigid 8.4.2.3

Foundation Ultimate Capacity Overturning



In cases for which the moment-to-shear ratio, M/H, on the soil–foundation interface is greater than the footing length ($M/H > L_f$), rocking behavior controls (M and H are defined in Fig. 8-1). For rectangular footings, the upper-bound moment capacity shall be determined using Eq. (8-10) with the expected values of P_{UD} and q using q_c multiplied by $(1 + C_v)$. The lower-bound moment capacity shall be determined with the expected values of P_{UD} and q and using q_c divided by $(1 + C_v)$. The expected vertical load P_{UD} is taken as the maximum action that can be developed based on a limit-state analysis considering the expected strength of the components delivering force to the footing; alternatively, the expected vertical load is determined by dividing the seismic linear elastic load by the maximum demand–capacity ratio (DCR) of the components in the load path and summing with the gravity loads.

$$M_{CE} = \frac{L_f P_{UD}}{2}\left(1 - \frac{q}{q_c}\right) \qquad \text{(8-10)}$$

where P_{UD} = expected vertical load on soil at the footing interface caused by gravity and seismic loads based on a limit-state analysis; or

$$= P_G \pm \frac{P_E}{\mathrm{DCR}}$$

Acceptance Criteria (AC) – Fixed Base

8.4.2.3.2 Acceptance Criteria for Linear Procedures

8.4.2.3.2.1 Foundation Modeled as a Fixed Base. If the base of the structure is assumed to be completely rigid, the foundation overturning action shall be classified as deformation controlled. The overturning demand Q_{UD} shall be determined using Eq. (7-34) and the soil shall be evaluated using Eq. (7-36) with $Q_{CE} = M_{CE}$. The *m*-factors for overturning compression shall be 2.0 for Immediate Occupancy, 3.0 for Life Safety, and 4.0 for Collapse Prevention, and the use of upper-bound component capacities shall be permitted. Where overturning results in an axial uplift force demand on the foundation, this uplift action shall be evaluated using an *m*-factor of 4.0 for Immediate Occupancy, 6.0 for Life Safety, and 8.0 for Collapse Prevention applied to the expected restoring dead load.

$$Q_{UD} = Q_G + Q_E \tag{7-34}$$

$$Q_{UF} = Q_G \pm \frac{\chi Q_E}{C_1 C_2 J} \tag{7-35}$$

$$m\kappa Q_{CE} > Q_{UD} \tag{7-36}$$

$$\kappa Q_{CL} > Q_{UF} \tag{7-37}$$

Questions

5. **Comments from the Public/Committee Members on issues not on this agenda**

Facilitator: Rami Elhassan, Committee Chair (or designee)

The Committee will receive comments from the Public/Committee Members. Matters raised at this time may be taken under consideration for placement on a subsequent agenda.